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Title: Optimization of Fenton process using response surface methodology and analytic hierarchy process for landfill leachate treatment

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1 **Optimization of Fenton process using response surface methodology and analytic hierarchy process**
2 **for landfill leachate treatment**

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8
9 **Abstract**

10 Typically, to treat landfill leachate, biological techniques alone are not sufficient. In this study, Fenton
11 process was found to be effective as a pretreatment method. Analytic hierarchy process (AHP) was used
12 to select the favorable catalyst between FeSO₄ and FeCl₂ when three criteria, namely, (i) COD removal,
13 (ii) sludge to iron ratio, and (iii) risk were considered. Meanwhile, response surface methodology was
14 applied to model and optimize three target responses, (i) COD removal, (ii) sludge to iron ratio, and (iii)
15 organic removal to sludge ratio. The effective variables included pH, [H₂O₂]/[Fe²⁺], Fe²⁺ dosage and
16 reaction time. In addition, to minimize the danger, generated sludge was reused in the Fenton process.
17 According to AHP sensitivity analysis results, priority percentage for FeCl₂ and FeSO₄ were 64% and
18 36%, respectively. Additionally, according to the statistical analysis, all suggested models were adequate
19 (with R² of 0.9171 to 0.9617). The optimum condition was found to be pH=6,
20 [H₂O₂]/[Fe²⁺]=20 mole ratio, [Fe²⁺]=170 mM, and reaction time=105 min. Results showed that
21 [H₂O₂]/[Fe²⁺] and [Fe²⁺] are significant for COD removal while pH and [H₂O₂]/[Fe²⁺] were important
22 factors for sludge to iron ratio (SIR) and organic removal to sludge ratio (ORSR), respectively.
23 Meanwhile, when iron sludge was reused as catalyst, the results were acceptable even after five times
24 regeneration.

25 *Keywords:* Leachate treatment, Fenton process, Response surface methodology, Analytic hierarchy
26 process, Iron sludge reuse.

27
28 **1. Introduction**

29 Sanitary landfill as an economical method for disposal of municipal solid waste (MSW) has been
30 practiced for decades all around the world. The most significant trouble in these landfills is the
31 uncontrolled release of leachate and hence contamination of ground and surface water streams (Amiri and
32 Sabour, 2014). Leachate is an aqueous liquid stream resulted from waste landfill site due to percolation of
33 rainwater through the waste, inherent moisture, and biochemical reactions occurring within the landfill
34 (Oulego et al., 2015). Several factors influence the quality and quantity of leachates such as elapsed time,

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